WHAT IS CLAIMED IS:

1. A turbine apparatus to be driven by a water, comprising a runner rotatable to be rotationally driven by the water, a flow rate adjuster for adjusting a flow rate of the water to change an actual rotational speed of the runner, and a control device for generating a control signal for controlling the flow rate adjuster so that a difference between the actual rotational speed of the runner and a desired rotational speed of the runner is decreased,

wherein the control device includes an input port for receiving a runner speed signal whose value corresponds to the actual rotational speed of the runner so that an input signal whose value corresponds to the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is generated, a derivative calculation element for generating a derivative component of the control signal whose value corresponds to a value to be applied to the derivative calculation element and the integration calculation element by performing differentiation on the value of the input signal with respect to a time proceeding and an integration calculation element for generating an integral component of the control signal whose value corresponds to a value to be applied to the derivative calculation element and the integration calculation element by performing integration on the value of the input signal

with respect to the time proceeding, and

a ratio of a gain of the derivative calculation element to a gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is not more than a predetermined degree is greater than a ratio of the gain of the derivative calculation element to the gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is more than the predetermined degree.

2. A turbine apparatus according to claim 1, wherein the ratio of the gain of the derivative calculation element to the gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is not more than the predetermined degree is greater than a ratio of the gain of the derivative calculation element to the gain of the integration calculation element to be applied to the derivative calculation element and the integration

calculation element when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is more than the predetermined degree, when a head of the water for driving rotationally the runner is not more than a predetermined value, and

the ratio of the gain of the derivative calculation element to the gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is not more than the predetermined degree is prevented from being greater than the ratio of the gain of the derivative calculation element to the gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is more than the predetermined degree, when the head of the water for driving rotationally the runner is more than the predetermined value.

3. A turbine apparatus according to claim 1, wherein when Q is the flow rate of the water for driving rotationally the runner, H is a head of the water for driving rotationally the runner, N is the

actual rotational speed of the runner, T is a torque for driving rotationally the runner, $N_1 = N/\sqrt{H}$, $Q_1 = Q/\sqrt{H}$, and $T_1 = T/H$,

the ratio of the gain of the derivative calculation element to the gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is not more than the predetermined degree is greater than a ratio of the gain of the derivative calculation element to the gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is more than the predetermined degree, under at least one of a case in which $\partial Q_1/\partial N_1>0$, a case in which $\partial T_1/\partial N_1>0$, a case in which an absolute value of $\partial Q_1/\partial N_1$ is more than a first value, and a case in which an absolute value of $\partial T_1/\partial N_1$ is more than a second value, and

the ratio of the gain of the derivative calculation element to the gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element when the difference between the actual rotational speed of the runner and the desired

rotational speed of the runner is not more than a predetermined degree is prevented from being greater than the ratio of the gain of the derivative calculation element to the gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is more than the predetermined degree, under a case in which $\partial Q_1/\partial N_1 \leqq 0$, $\partial T_1/\partial N_1 \leqq 0$, the absolute value of $\partial Q_1/\partial N_1$ is not more than the first value, and the absolute value of $\partial T_1/\partial N_1$ is not more than the second value.

4. A turbine apparatus according to claim 1, wherein during an increase of the actual rotational speed of the runner from zero toward the desired rotational speed of the runner, the ratio of the gain of the derivative calculation element to the gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element after the difference between the actual rotational speed of the runner and the desired rotational speed of the runner becomes not more than the predetermined degree is greater than the ratio of the gain of the derivative calculation element to the gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element before the difference

between the actual rotational speed of the runner and the desired rotational speed of the runner becomes not more than the predetermined degree.

5. A turbine apparatus according to claim 1, wherein the gain of the derivative calculation element to be applied to the derivative calculation element when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is not more than the predetermined degree is not less than the gain of the derivative calculation element to be applied to the derivative calculation element when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is more than the predetermined degree, and the gain of the integration calculation element to be applied to the integration calculation element when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is not more than the predetermined degree is less than the gain of the integration calculation element to be applied to the integration calculation element when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is more than the predetermined degree.

6. A turbine apparatus according to claim 1, wherein the runner is connectable to an electric power generator to drive the electric power generator, the

ratio of the gain of the derivative calculation element to the gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is not more than the predetermined degree is greater than a ratio of the gain of the derivative calculation element to the gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is more than the predetermined degree, when the electric power generator is prevented from supplying an electric power to electric power transmission lines, and

a ratio of the gain of the derivative calculation element to the gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element when the electric power generator is allowed to supply the electric power to the electric power transmission lines smaller than the ratio of the gain of the derivative calculation element to the gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element when the difference between the actual rotational speed of the runner and the desired

rotational speed of the runner is not more than the predetermined degree and the electric power generator is prevented from supplying the electric power to the electric power transmission lines.

7. A turbine apparatus according to claim 1, wherein the runner is rotatable in either of a normal direction for being driven by the water and a reverse direction for pumping the water when the runner is prevented from being operated to drive the electric power generator.

8. A turbine apparatus according to claim 1, further comprising a proportional calculation element for generating a proportional component of the control signal whose value is proportional to the value of input signal, wherein the control device is a governor in accordance with IEC International Standard 61362 First Edition, the gain of the derivative calculation element is more than 5 and a gain of the proportional calculation element is less than 0.5, when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is not more than the predetermined degree.

9. A turbine apparatus according to claim 8, wherein the gain of the proportional calculation element is more than 0.6, when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is more than the predetermined degree.

10. A turbine apparatus according to claim 1, wherein the runner is connectable to an electric power generator to drive the electric power generator, the flow rate of the water for driving the runner is rapidly increased just after the electric power generator is electrically connected to electric power transmission lines to supply the electric power from the electric power generator to the electric power transmission lines after the actual rotational speed of the runner is synchronized in S-characteristic portion of the runner with required frequency of alternating electric current of the electric power transmission lines, from the flow rate of the water for no-load operation in which the runner is rotationally driven by the water when the electric power generator is prevented from supplying the electric power to the electric power transmission lines, so that an operating point of the runner is moved away rapidly from the S-characteristic portion.

11. A turbine apparatus to be driven by a water, comprising a runner rotatable to be rotationally driven by the water, a flow rate adjuster for adjusting a flow rate of the water to change an actual rotational speed of the runner, and a control device for generating a control signal for controlling the flow rate adjuster so that a difference between the actual rotational speed of the runner and a desired rotational speed of the runner is decreased,

wherein the control device includes an input port for receiving a runner speed signal whose value corresponds to the actual rotational speed of the runner so that an input signal whose value corresponds to the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is generated, a derivative calculation element for generating a derivative component of the control signal whose value corresponds to a value to be applied to the derivative calculation element and the integration calculation element by performing differentiation on the value of the input signal with respect to a time proceeding and an integration calculation element for generating an integral component of the control signal whose value corresponds to a value to be applied to the derivative calculation element and the integration calculation element by performing integration on the value of the input signal with respect to the time proceeding, and

when Q is the flow rate of the water for driving rotationally the runner, H is a head of the water for driving rotationally the runner, N is the actual rotational speed of the runner, T is a torque for driving rotationally the runner, $N_1 = N/\sqrt{H}$, $Q_1 = Q/\sqrt{H}$, and $T_1 = T/H$,

under at least one of a case in which $\partial Q_1/\partial N_1>0$, a case in which $\partial T_1/\partial N_1>0$, a case in which the absolute value of $\partial Q_1/\partial N_1$ is more than the first value,

and a case in which the absolute value of $\partial T_1/\partial N_1$ is more than the second value, a transition from increase to decrease of an opening area of the flow rate adjuster occurs with a delay in phase angle not more than 120 degrees from a transition from increase to decrease of the actual rotational speed of the runner.

12. A turbine apparatus to be driven by a water, comprising a runner rotatable to be rotationally driven by the water, a flow rate adjuster for adjusting a flow rate of the water to change an actual rotational speed of the runner, and a control device for generating a control signal for controlling the flow rate adjuster so that a difference between the actual rotational speed of the runner and a desired rotational speed of the runner is decreased,

wherein the control device includes an input port for receiving a runner speed signal whose value corresponds to the actual rotational speed of the runner so that an input signal whose value corresponds to the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is generated, a derivative calculation element for generating a derivative component of the control signal whose value corresponds to a value to be applied to the derivative calculation element and the integration calculation element by performing differentiation on the value of the input signal with respect to a time proceeding and an integration

calculation element for generating an integral component of the control signal whose value corresponds to a value to be applied to the derivative calculation element and the integration calculation element by performing integration on the value of the input signal with respect to the time proceeding, and

when Q is the flow rate of the water for driving rotationally the runner, H is a head of the water for driving rotationally the runner, N is the actual rotational speed of the runner, T is a torque for driving rotationally the runner, $N_1 = N/\sqrt{H}$, $Q_1 = Q/\sqrt{H}$, and $T_1 = T/H$,

under at least one of a case in which $\partial Q_1/\partial N_1>0$, a case in which $\partial T_1/\partial N_1>0$, a case in which an absolute value of $\partial Q_1/\partial N_1$ is more than a first value, and a case in which an absolute value of $\partial T_1/\partial N_1$ is more than the second value, a transition from decrease to increase of the opening area of the flow rate adjuster occurs with a delay in phase angle not more than 120 degrees from a transition from decrease to increase of the actual rotational speed of the runner.

13. A governor for adjusting a flow rate of a water to change an actual rotational speed of a runner rotationally driven by the water, comprising a control device for generating a control signal corresponding to the flow rate of the water to be applied to the runner in such a manner that a difference between an actual rotational speed of the runner and a desired rotational

speed of the runner is decreased,

wherein the control device includes an input port for receiving a runner speed signal whose value corresponds to the actual rotational speed of the runner so that an input signal whose value corresponds to the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is generated, a derivative calculation element for generating a derivative component of the control signal whose value corresponds to a value to be applied to the derivative calculation element and the integration calculation element by performing differentiation on the value of the input signal with respect to a time proceeding and an integration calculation element for generating an integral component of the control signal whose value corresponds to a value to be applied to the derivative calculation element and the integration calculation element by performing integration on the value of the input signal with respect to the time proceeding, and

a ratio of a gain of the derivative calculation element to a gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is not more than a predetermined degree is greater than a ratio of the

gain of the derivative calculation element to the gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is more than the predetermined degree.

14. A turbine apparatus to be driven by a water, comprising a runner rotatable to be rotationally driven by the water, a flow rate adjuster for adjusting a flow rate of the water to change an actual rotational speed of the runner, and a control device for generating a control signal for controlling the flow rate adjuster so that a difference between the actual rotational speed of the runner and a desired rotational speed of the runner is decreased,

wherein the control device includes an input port for receiving a runner speed signal whose value corresponds to the actual rotational speed of the runner so that an input signal whose value corresponds to the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is generated, a derivative calculation element for generating a derivative component of the control signal whose value corresponds to a value to be applied to the derivative calculation element and the integration calculation element by performing differentiation on the value of the input signal with

respect to a time proceeding and an integration calculation element for generating an integral component of the control signal whose value corresponds to a value to be applied to the derivative calculation element and the integration calculation element by performing integration on the value of the input signal with respect to the time proceeding, and

a ratio of a gain of the derivative calculation element to a gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element when a head of the water for driving rotationally the runner is not more than a predetermined value is greater than a ratio of the gain of the derivative calculation element to the gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element when the head of the water for driving rotationally the runner is more than the predetermined value.

15. A turbine apparatus to be driven by a water, comprising a runner rotatable to be rotationally driven by the water, a flow rate adjuster for adjusting a flow rate of the water to change an actual rotational speed of the runner, and a control device for generating a control signal for controlling the flow rate adjuster so that a difference between the actual rotational speed of the runner and a desired rotational speed of

the runner is decreased,

wherein the control device includes an input port for receiving a runner speed signal whose value corresponds to the actual rotational speed of the runner so that an input signal whose value corresponds to the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is generated, a derivative calculation element for generating a derivative component of the control signal whose value corresponds to a value to be applied to the derivative calculation element and the integration calculation element by performing differentiation on the value of the input signal with respect to a time proceeding and an integration calculation element for generating an integral component of the control signal whose value corresponds to a value to be applied to the derivative calculation element and the integration calculation element by performing integration on the value of the input signal with respect to the time proceeding, and

when Q is the flow rate of the water for driving rotationally the runner, H is a head of the water for driving rotationally the runner, N is the actual rotational speed of the runner, T is a torque for driving rotationally the runner, $N_1 = N/\sqrt{H}$, $Q_1 = Q/\sqrt{H}$, and $T_1 = T/H$,

a ratio of a gain of the derivative calculation element to a gain of the integration

calculation element to be applied to the derivative calculation element and the integration calculation element under at least one of a case in which $\partial Q_1/\partial N_1>0$, a case in which $\partial T_1/\partial N_1>0$, a case in which an absolute value of $\partial Q_1/\partial N_1$ is more than a first value, and a case in which an absolute value of $\partial T_1/\partial N_1$ is more than a second value is greater than a ratio of the gain of the derivative calculation element to the gain of the integration calculation element to be applied to the derivative calculation element and the integration calculation element under a case in which $\partial Q_1/\partial N_1 \leqq 0$, $\partial T_1/\partial N_1 \leqq 0$, the absolute value of $\partial Q_1/\partial N_1$ is not more than the first value, and the absolute value of $\partial T_1/\partial N_1$ is not more than the second value.

16. A turbine apparatus to be driven by a water, comprising a runner rotatable to be rotationally driven by the water, a flow rate adjuster for adjusting a flow rate of the water by changing an opening area of the flow rate adjuster so that an actual rotational speed of the runner is changed, and a control device for generating a control signal corresponding to an opening area of the flow rate adjuster in such a manner that a difference between the actual rotational speed of the runner and a desired rotational speed of the runner is decreased,

wherein the control device includes an input port for receiving a runner speed signal whose value corresponds to the actual rotational speed of the

runner so that an input signal whose value corresponds to the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is generated, and

when Q is the flow rate of the water for driving rotationally the runner, H is a head of the water for driving rotationally the runner, N is the actual rotational speed of the runner, T is a torque for driving rotationally the runner, $N_1 = N/\sqrt{H}$, $Q_1 = Q/\sqrt{H}$, and $T_1 = T/H$,

a variation of the control signal is in advance of a variation of the input signal under at least one of a case in which $\partial Q_1/\partial N_1>0$, a case in which $\partial T_1/\partial N_1>0$, a case in which an absolute value of $\partial Q_1/\partial N_1$ is more than a first value, and a case in which an absolute value of $\partial T_1/\partial N_1$ is more than a second value.

17. A turbine apparatus according to claim 16, wherein the variation of the control signal is in advance of the variation of the input signal by 30-90 degrees in phase angle.

18. A turbine apparatus to be driven by a water, comprising a runner rotatable to be rotationally driven by the water, a flow rate adjuster for adjusting a flow rate of the water to change an actual rotational speed of the runner, and a control device for generating a control signal corresponding to an opening area of the flow rate adjuster in such a manner that a difference between the actual rotational speed of the runner and a

desired rotational speed of the runner is decreased,

wherein the control device includes an input port for receiving a runner speed signal whose value corresponds to the actual rotational speed of the runner so that an input signal whose value corresponds to the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is generated, a derivative calculation element for generating a derivative component of the control signal whose value corresponds to a value to be applied to the derivative calculation element and the integration calculation element by performing differentiation on the value of the input signal with respect to a time proceeding and an integration calculation element for generating an integral component of the control signal whose value corresponds to a value to be applied to the derivative calculation element and the integration calculation element by performing integration on the value of the input signal with respect to the time proceeding, and

when Q is the flow rate of the water for driving rotationally the runner, H is a head of the water for driving rotationally the runner, N is the actual rotational speed of the runner, T is a torque for driving rotationally the runner, $N_1 = N/\sqrt{H}$, $Q_1 = Q/\sqrt{H}$, and $T_1 = T/H$,

a ratio of a gain of the derivative calculation element to a gain of the integration

calculation element to be applied to the derivative calculation element and the integration calculation element when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is not more than a predetermined degree is determined in such a manner that a variation of the control signal is in advance of a variation of the input signal under at least one of a case in which $\partial Q_1/\partial N_1>0$, a case in which $\partial T_1/\partial N_1>0$, a case in which an absolute value of $\partial Q_1/\partial N_1$ is more than a first value, and a case in which an absolute value of $\partial T_1/\partial N_1$ is more than a second value.

19. A turbine apparatus according to claim 18, wherein the variation of the control signal is in advance of the variation of the input signal by 30-90 degrees in phase angle.

20. A turbine apparatus according to claim 18, further comprising a proportional calculation element for generating a proportional component of the control signal whose value is proportional to the value of input signal, wherein a ratio of a gain of the derivative calculation element to a gain of the proportional calculation element to be applied to the derivative calculation element and the proportional calculation element when the difference between the actual rotational speed of the runner and the desired rotational speed of the runner is not more than the predetermined degree is determined in such a manner

that the variation of the control signal is in advance of the variation of the input signal under at least one of a case in which $\partial Q_1/\partial N_1>0$, a case in which $\partial T_1/\partial N_1>0$, a case in which an absolute value of $\partial Q_1/\partial N_1$ is more than a first value, and a case in which an absolute value of $\partial T_1/\partial N_1$ is more than a second value.